

## **CHAPTER 2**

### **Description of Alternatives**

#### **2.1 Proposed Action**

In order to meet the need for renewable electricity marketed by its Green Power Switch (GPS) program, TVA proposes to acquire about 20 MW of electricity generated by wind. TVA began the process of acquiring this energy by issuing a Request for Proposals (RFP) in July, 2001. The RFP specified the following requirements:

- 40 - 50 MW of installed wind generation capacity, depending upon the site(s) selected.
- 20 - 25 MW of wind generation capacity installed and in commercial operation by October 2003.
- The remaining 20 - 30 MW of wind generation capacity in commercial operation by October 2004.
- The windfarm must be located within the TVA power service area.
- The windfarm must connect to the TVA transmission system at 161-kV or 69-kV, or to a local utility's distribution system.

TVA specified two approaches for satisfying its need to obtain the requisite wind-generated electricity. Under the turnkey approach, TVA would contract with a company experienced in wind energy development to build the windfarm, which TVA would own and operate. Under the Power Purchase Agreement (PPA) approach, a company experienced in wind energy development would construct, own, and operate the windfarm, and TVA would enter into a long term contract to purchase all of the electricity generated by the windfarm.

TVA provided RFP respondents with information on the wind resource conditions, land ownership, and nearby transmission system characteristics for five sites it had identified as potentially suitable for the proposed windfarm. Characteristics of these sites included adequate wind resource, interested landowners, road access, proximity to the TVA transmission system, and, based on preliminary evaluations, environmental suitability. None of the RFP respondents proposed other windfarm sites.

Following further evaluation of its projected GPS energy demand, TVA revised its RFP in November 2001 by reducing the size of the windfarm to 19.5 - 21 MW. The list of potential windfarm sites was also reduced to two, Buffalo Mountain in Anderson County, Tennessee, and Stone Mountain in Johnson County, Tennessee. This change was based on the responses to the original RFP and site-specific efficiencies of constructing and operating a smaller windfarm. The windfarm is to be in commercial operation by October 2003.

TVA is also considering the construction and operation of an associated 12 MW Regenesys™ energy storage facility. TVA considered and rejected other energy storage technologies based on their life-cycle costs, environmental impacts, and energy storage capacity. This discussion is contained in TVA's August 2001 Environmental Assessment - The Regenesys™ Energy Storage System.

#### **2.2 Action Alternatives**

TVA is considering two action alternatives, each consisting of the construction and operation of a 19.5 to 21 MW windfarm, associated transmission line connections and an electrical substation, and a Regenesys™ energy storage facility. Under Alternative 1, the windfarm would be built on Buffalo Mountain in Anderson County, Tennessee. Under Alternative 2, the windfarm would be built on Stone Mountain in Johnson County, Tennessee. Under either of these alternatives, TVA intends to have the windfarm completed and operating by October, 2003.

As described above in Section 2.1 - Proposed Action, TVA is considering two approaches for obtaining wind-generated power for the GPS program. The environmental impacts of the turnkey and PPA approaches are expected to be the same, and therefore the two approaches are not separately discussed in the alternatives analyses.

The Regenesys™ facility is treated as a sub-alternative of each action alternative. As a part of each Regenesys™ sub-alternative, TVA is also considering more than one potential site for the Regenesys™ facility; these different sites are treated as options in the alternative descriptions. The windfarm could be constructed under either Alternative 1 or Alternative 2 without the associated Regenesys™ facility; the Regenesys™ facility, however, would not be built without the windfarm. Construction of the Regenesys™ facility would begin later than construction of the windfarm, and it would not be completed until at least 2004 or 2005.

The two action alternatives have many features in common, including the number and type of wind turbines to be used, turbine construction techniques, the electrical collection system, and characteristics of the Regenesys™ facility. These common features are described below, and are followed by descriptions of the site-specific features of each action alternative.

#### Turbine Description

The project would use 13 to 16 wind turbines. Three turbine models are under consideration: the Enron Wind 1.5 / 70.5, the NEG/Micon 1500 72C, and the Nordex N62/1300. If the Enron or NEG/Micon turbines are selected, 13 or 14 turbines would be used. If the Nordex turbine is selected, 16 turbines would likely be used. All three turbine models are state-of-the-art, three-bladed, upwind, horizontal-axis models. The generator is located in a nacelle mounted on a tubular steel tower. Electronic controls rotate the nacelle to face into the wind, and adjust the pitch of the blades to regulate rotor speed. Other design features of the turbine models, as well as the existing wind turbines at Buffalo Mountain, are listed in Table 2-1. Exterior surfaces of the wind turbines would be white or grayish-white.

Because of their height of the wind turbines, aircraft warning lights would be required on at least some of the towers. The exact number and type of lights will be determined in consultation with the Federal Aviation Administration and will incorporate U.S. Fish and Wildlife Service guidelines.

#### Turbine Construction

A permanent gravel access road about 16 feet wide would be built along the length of the row of turbines. An area of about one acre would then be cleared at each turbine site to provide room for assembling and installing the turbine components. Portions of this area would be graded as necessary for a crane pad and material assembly. Most of this area would be revegetated once construction is completed.

Each wind turbine would rest on a cylindrical concrete foundation 15 - 20 feet in diameter. The depth of the foundation is dependent on existing soil and bedrock conditions, and may be up to 35 feet deep. Foundation excavation would be done using standard excavation equipment and could require blasting. Once the foundations are completed, the surrounding area would be restored as nearly as possible to its preconstruction condition. The turbines would be erected in sections using a large crane to lift components into position and a smaller crane to move parts and assemble the rotors. Once construction is completed, a security fence would be installed around the base of each turbine.

Table 2-1. Design features of wind turbine models under consideration for the proposed windfarm, as well as the Vestas V47 model currently in use at Buffalo Mountain.

Design Feature	Turbine Model			
	Enron Wind* 1.5/70.5	NEG/Micon 1500 72C	Nordex N62/1300	Vestas V47
Output	1.5 MW	1.5 MW	1.3 MW	0.66 MW
Rotor Diameter	231 ft (70.5 m)	236 ft (72 m)	204 ft (62 m)	154 ft (47 m)
Rotor Hub Height	213 ft (65 m) or 262 ft (80 m)	230 ft (70 m)	226 ft (69 m)	213 ft (65 m)
Rotor Swept Area	42,001 ft <sup>2</sup> (3902 m <sup>2</sup> )	43,831 ft <sup>2</sup> (4072 m <sup>2</sup> )	32,685 ft <sup>2</sup> (3020 m <sup>2</sup> )	18,676 ft <sup>2</sup> (1735 m <sup>2</sup> )
Operating Wind Speed	7 - 56 mph (3 - 25 m/s)	9 - 56mph (4 - 25 m/s)	6 - 56 mph (2.5 - 25 m/s)	9 - 56 mph (4 - 25 m/s)
Maximum Power	≥ 27 mph	≥ 27 mph	≥ 34 mph	≥ 34 mph
Output Wind Speed	(12 m/s)	(12 m/s)	(15 m/s)	(15 m/s)
Operating Rotor Speed	11.8 - 20 rpm	17.3 rpm	12.8 - 19.2 rpm	28.5 rpm
Maximum Blade Tip Speed	165 mph (73.8 m/s)	143 mph (64 m/s)	139 mph (62.3 m/s)	157 mph (70 m/s)

Source: Manufacturers information.

\*Enron Wind was purchased by GE Power Systems, a division of General Electric Corporation, in April 2002.

### Electrical Collection System

The wind turbines would generate power at 575, 600, or 690 volts (depending on the model), which would be delivered to a transformer located near the base of each turbine. These transformers would step up the voltage to 13.2, 26, or 34.5 kilovolts. Each of these transformers would be mounted on a concrete pad, and located within the security fence. Buried electrical cables would deliver electricity from the stepup transformers to a common connection point, which connects to a substation.

### Regenesys™ Energy Storage Facility

The principal components of the Regenesys™ Energy Storage Facility are:

- Regenerative modules located in a main process building.
- Two electrolyte storage tanks.
- A process facility, including an electrolyte circulation system.
- A power conversion system, including an inverter/rectifier, transformer, and alternating current breaker.
- Control systems.
- Auxiliary systems that include electrolyte and power conversion system cooling, and an electrolyte management system.

The plant layout, including parking facilities, would cover approximately four acres. The process building (approximately 175 feet long, 65 feet wide, and 60 feet tall) would contain required modules, electrolyte circulation pumps, electrolyte supply headers, and associated pipework. The cylindrical electrolyte storage tanks (30 feet tall and approximately 65 feet in diameter) would be installed adjacent to the process building. One tank would hold 475,000 gallons of sodium bromide. The other tank would hold 570,000 gallons of sodium polysulfide. A wall would be erected around the tanks to serve as a

visual screen and chain link fencing would surround the entire site once construction is complete. A plan view of the Regenesys™ facility is displayed in Figure 2-1.

#### Regenesys™ Construction

Construction of the Regenesys™ facility would include erection of the process building and cylindrical storage tanks. Similar to wind turbine foundations, the footings required for both the building and tanks would depend on the existing soil and bedrock. The foundations for the tanks would be more extensive than the foundation required for the process building. It may also be necessary to construct a storm water detention basin for capturing runoff from the developed area.

Actual construction of the facility, including the auxiliary components and required piping is expected to last approximately one year. Commissioning of the facility would be completed six months after construction is complete.

### **2.2.1 Alternative 1: Buffalo Mountain Windfarm Expansion**

Buffalo Mountain is located in Anderson County, Tennessee, about 5.5 miles north of the town of Oliver Springs. It is the site of TVA's existing Buffalo Mountain Windfarm, consisting of three 660 kW wind turbines constructed in September, 2000. Figure 2-2 shows the location of the major windfarm components.

#### Access Roads

An existing gravel road from State Highway 116 would be used to transport turbine components and construction equipment to the site. Portions of this road would likely be graded.

#### Electrical Connection and Project Substation

The underground electrical collection cables would directly connect to an on-site project substation. The project substation would consist of transformers stepping the voltage up to between 24- and 69-kV and associated circuit breakers, switches, circuit protection, metering, and telemetry equipment. This equipment would occupy a 1 or 2 acre site which would be graded and covered with gravel. It would be surrounded by a security fence, and be constructed with appropriate spill and runoff containment facilities.

The project substation would be connected to the area electrical grid by a 3 to 4 mile long transmission line. The voltage of this line has yet to be determined but would be between 24 and 69-kV. The line would cross Buffalo Mountain to the south and descend adjacent Windrock Mountain following the right-of-way for the distribution line built for TVA's existing windfarm. The existing right-of-way would likely be expanded to a width of up to 100 feet, depending on the line voltage, and the existing poles may be replaced with new structures.

### **Regenesys™ Facility Sub-Alternative**

TVA is considering four sites for the Regenesys™ facility. The location of each of these sites is shown in Figure 2-3. Two potential sites were considered in the Draft EA, the Braden Field site described below, and the Freels Farm site, located about half a mile northeast of the junction of State Highways 61 and 62, and about 2.7 miles southeast of Oliver Springs. At both of these two original sites, the interconnection to the area electrical transmission grid would have been to a nearby high voltage

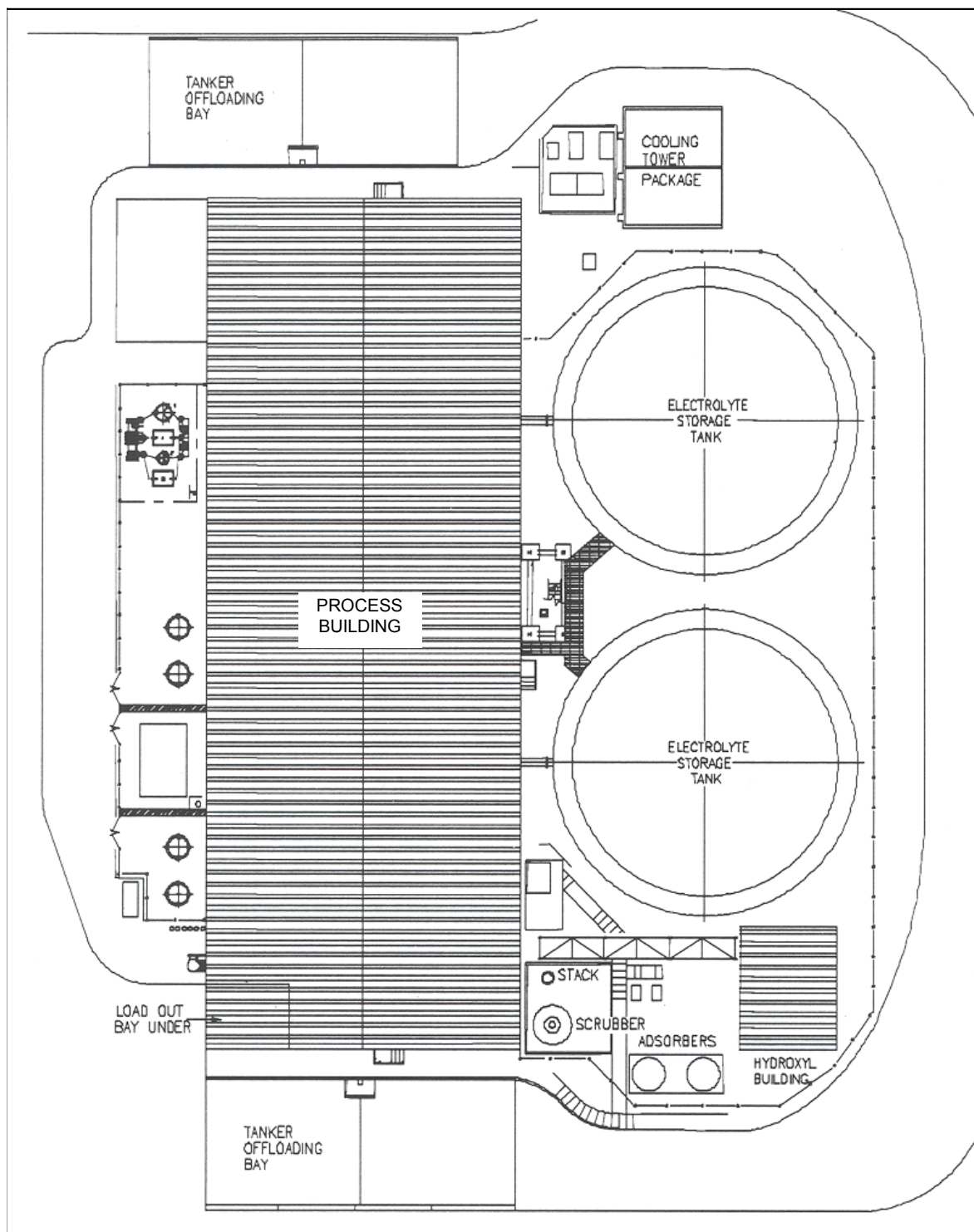


Figure 2-1. Plan view of the proposed Regenesys™ energy storage facility.

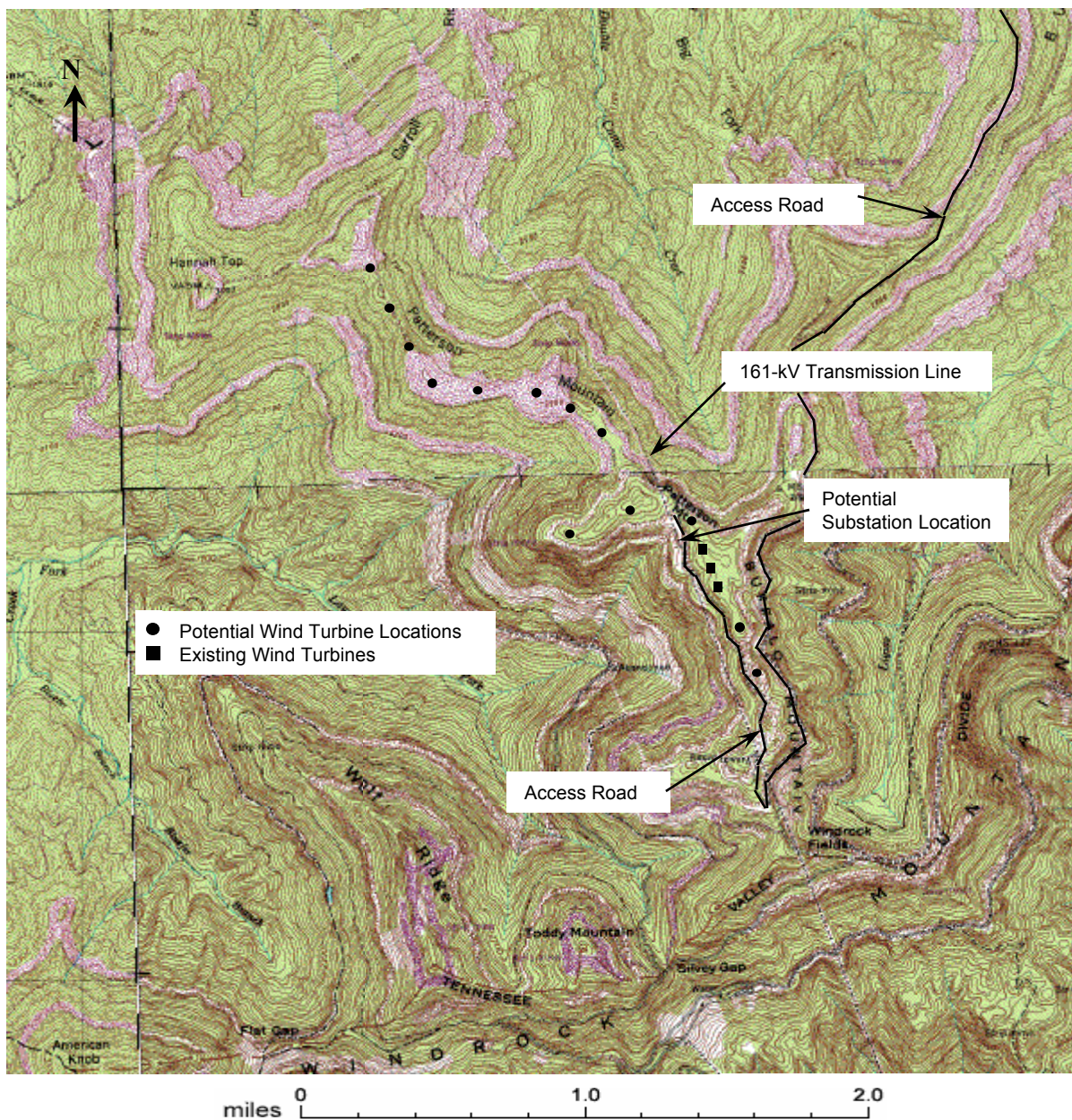


Figure 2-2. Location of proposed windfarm components on Buffalo Mountain in Anderson County, TN.

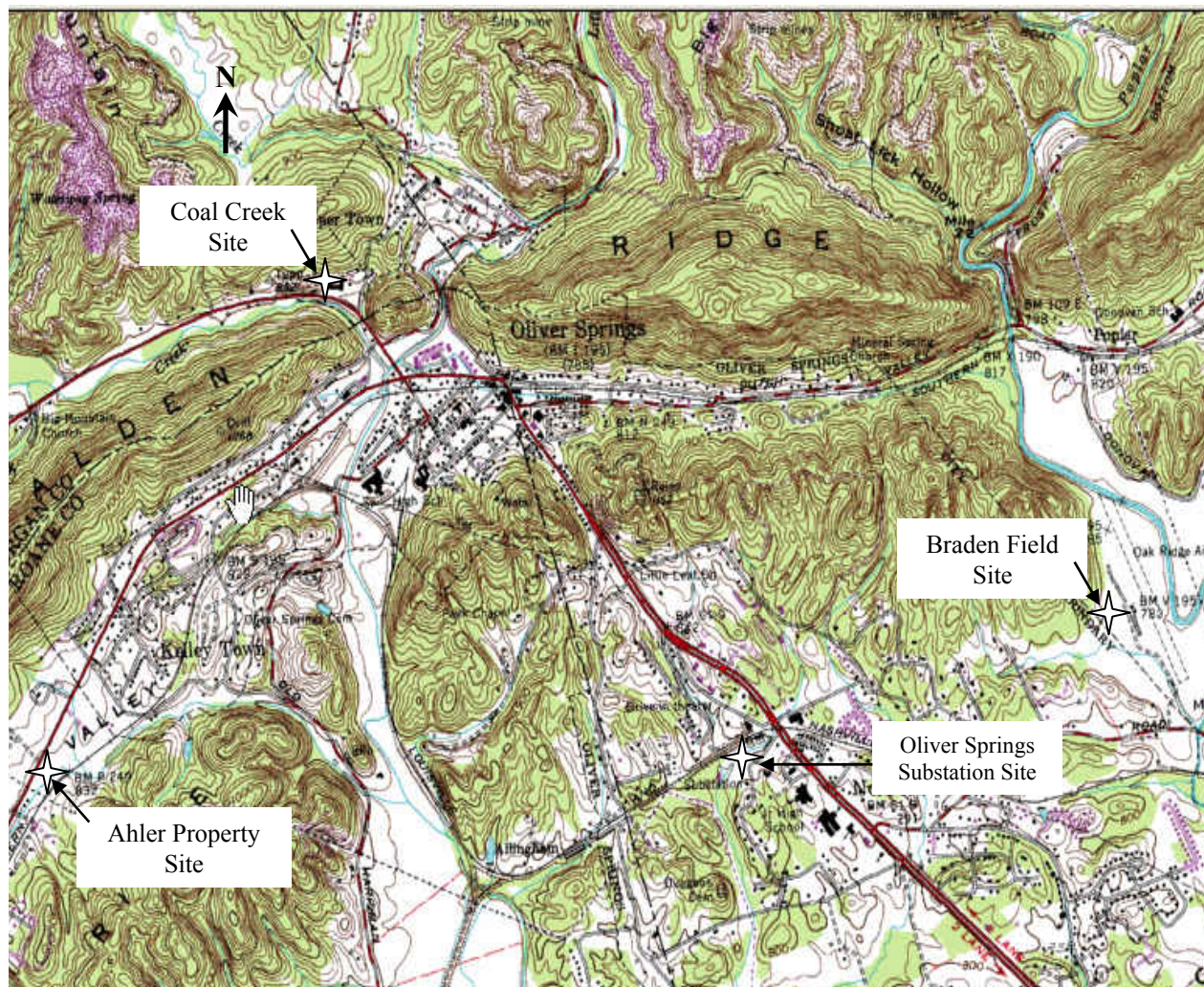


Figure 2-3. Potential Regenesys™ energy storage facility sites near Oliver Springs, TN.

transmission line. After further study, TVA decided to add additional potential sites which allowed the option of an interconnection to the local distributor's lower voltage distribution system. The Freels Farm site was therefore dropped from further consideration because it had greater visual impacts, required more access road construction, and was much closer to existing homes than the Braden Field site. Three new sites allowing interconnection with the lower voltage distribution system were added and described below as Options 2, 3, and 4.

#### *Option 1 – Braden Field Regenesys™ Site*

The Braden Field site is located on the west side of Oak Ridge Airpark, about 1.9 miles southeast of Oliver Springs.

#### Electrical Connection

The Regenesys™ facility would be connected to an existing TVA 161-kV transmission line on the east side of the airstrip. Due to the presence of the airstrip, the interconnect would most likely be routed south, back to airport road and then east along airport road, utilizing the existing right-of-way. Alternatively, the interconnect may be routed underground to the east and under Poplar Creek. The proposed Regenesys™ site is about 900 feet from the transmission line.

#### Water and Sewage Connections

Water and sewer lines exist south of the site along Airport Road. New connections about one quarter mile long would be built to these lines southwest of the site.

#### *Option 2 – Coal Creek Site*

The Coal Creek site is just outside of the Oliver Springs city limits to the northwest on Highway 62. The site is an abandoned strip mine bench.

#### Access Roads

The site can currently be accessed by using the existing road on the north side of Highway 62. This road would be upgraded to increase width and reduce incline.

#### Electrical Connection

The interconnect would be routed along the existing 13-kV line right-of-way to one of two possible destinations: (1) approximately 3.5 miles to the Coalfield substation or; (2) less than 2 miles to the Oliver Springs substation.

#### Water and Sewage Connections

Water and sewage connections are available at the city limits, approximately 500 feet from the site. The lines from the Regenesys™ site would be routed along Highway 62.

#### *Option 3 – Ahler Property*

This site is located on the southeast side of Highway 61, approximately 2 miles outside of Oliver Springs. The site is bordered by a cement plant on the southeast, railroad tracks on the east, Highway 61 on the west and open land and a residential area on the north.

#### Access Roads

There are currently no roads from Highway 61 onto the property. A new access road would be constructed to the site and would be less than ½ mile long.

#### Electrical Connection

The interconnect would be overhead to the existing 69-kv line that runs between the Oliver Springs and Coalfield substations. The new interconnect would be less than 300 yards long.

#### Water and Sewage Connections

There is water available on the site and the connection from the Regenesys™ facility would be less than 100 yards. Sewage is available to the north along Highway 61, approximately ½ mile away.

#### *Option 4 – Oliver Springs Substation*

The Oliver Springs substation is located adjacent to railroad tracks about 0.3 miles east of Highway 61/62 and about 1.1 miles south-southeast of the center of Oliver Springs.

#### Access Roads

The new access road to the site would be routed from nearby Patterson Circle along the existing transmission line right-of-way.

#### Electrical Connection

The interconnect would be a short, overhead line (< 100feet) to the adjacent substation.

#### Water and Sewage Connections

Water and sewage connections would be routed along the new access road, back to Patterson Circle for connection to the existing water and sewer lines.

### **2.2.2 Alternative 2 – Stone Mountain Windfarm**

Stone Mountain is a narrow, southwest- to northeast-oriented mountain about 9 miles long located in Johnson County, Tennessee and Watauga County, North Carolina. The Tennessee-North Carolina state line runs along much of the crest of the mountain. The site under consideration is at the north end of the mountain, about 7 miles south of Mountain City. Figure 2-4 shows the location of the major windfarm components.

#### Access Roads

Two potential routes are under consideration for road access to transport turbine components and construction equipment to the site. One route would be via U.S. Highway 421 to Bulldog Road, which intersects Highway 421 about 9 miles south of Mountain City. From Bulldog Road at State Line Gap, an existing jeep trail about half a mile long that climbs Stone Mountain would be rebuilt and used. A switchback and small bridge on Bulldog Road near State Line Gap would likely be rebuilt to allow passage of oversize trucks. The second route would be via U.S. Highway 421 to Grover Reece Road, which intersects Highway 421 about 8.5 miles south of Mountain City. Grover Reece Road intersects with Stone Mountain Road, which extends onto the south end of the windfarm site. Some improvements to these roads may be necessary.

#### Electrical Connection and Project Substation

The underground electrical collection cables would connect to a project substation at the windfarm site. The project substation would be connected to the area electrical grid by a 3 to 4 mile long transmission line. The voltage of this line has yet to be determined but would be between 24 and 69-kV. The final route of this transmission line has not yet been determined. One route under consideration would follow the right-of-way for the existing distribution line running from the north end of Stone Mountain to the

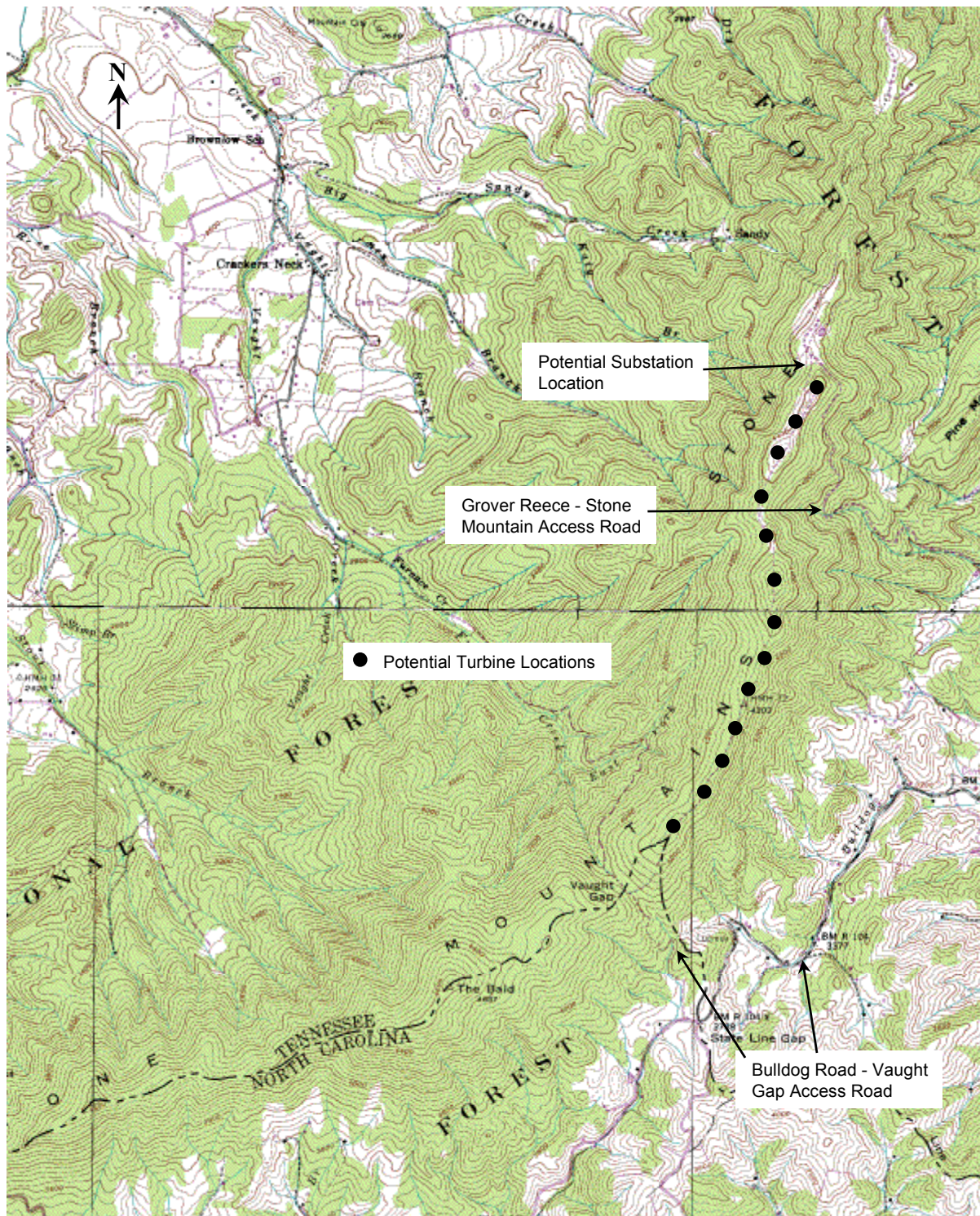


Figure 2-4. Location of proposed windfarm components on Stone Mountain in Johnson County, TN.

vicinity of the Shouns Substation. This right-of-way would likely be expanded to a width of up to 100 feet, depending on the line voltage, and the existing poles may be replaced with new structures. The project substation would consist of transformers stepping the voltage up to between 24- and 69-kV and associated circuit breakers, switches, circuit protection, metering, and telemetry equipment. This equipment would occupy a 1 to 2 acre site, which would be graded and covered with gravel. It would be surrounded by a security fence and be constructed with appropriate spill and runoff containment facilities.

#### Meteorology Tower

A permanent meteorological tower would be built near the center of the windfarm, on the western side of the ridge. The tower would likely be either 164 feet (50 m) or 214 feet (65 m) tall. Tower designs with and without guy wires are under consideration. If the tower is over 200 feet tall, an aircraft warning light would likely be required.

#### **Regenesys™ Facility Sub-Alternative**

TVA is considering three different sites for the Regenesys™ facility. The location of each of these sites is shown in Figure 2-5 and 2-6.

##### *Option 1 – Johnson County Industrial Park Regenesys™ Site*

This site is in the existing Johnson County Industrial Park, located near State Highway 67 about 4.5 miles southwest of Mountain City.

#### Access Roads

Access from Highway 67 to the proposed site is provided by Pedro Shouns Road. This road would not require any upgrades but construction of a short access road from Pedro Shouns Road to the site would be necessary.

#### Electrical Connection

A 69-kV transmission line owned by Mountain Electric Cooperative crosses through the industrial park and serves the nearby state prison. The connection from the facility to this line would be with a new overhead line less than one quarter mile in length. No other transmission line work between the area of the Shouns Substation at Mountain City and the industrial park would be required in order to serve the Regenesys™ facility.

#### Water and Sewage Connections

Water and sewer mains extend into the industrial park from Highway 67. Connections to these mains for service to the Regenesys™ facility would be to the north of the proposed site and less than one quarter mile long.

##### *Option 2 – Shouns Substation Regenesys™ Site*

This site is located along State Highway 167 about 0.7 mile south of its intersection with U.S. Highway 421 and 3 miles south of Mountain City. The site is on the south side of the existing substation.

#### Access Roads

The existing gravel access road from Highway 167 to the substation would be extended to the site, widened, and paved. The road would likely circle the substation and be about one-fourth a mile long.

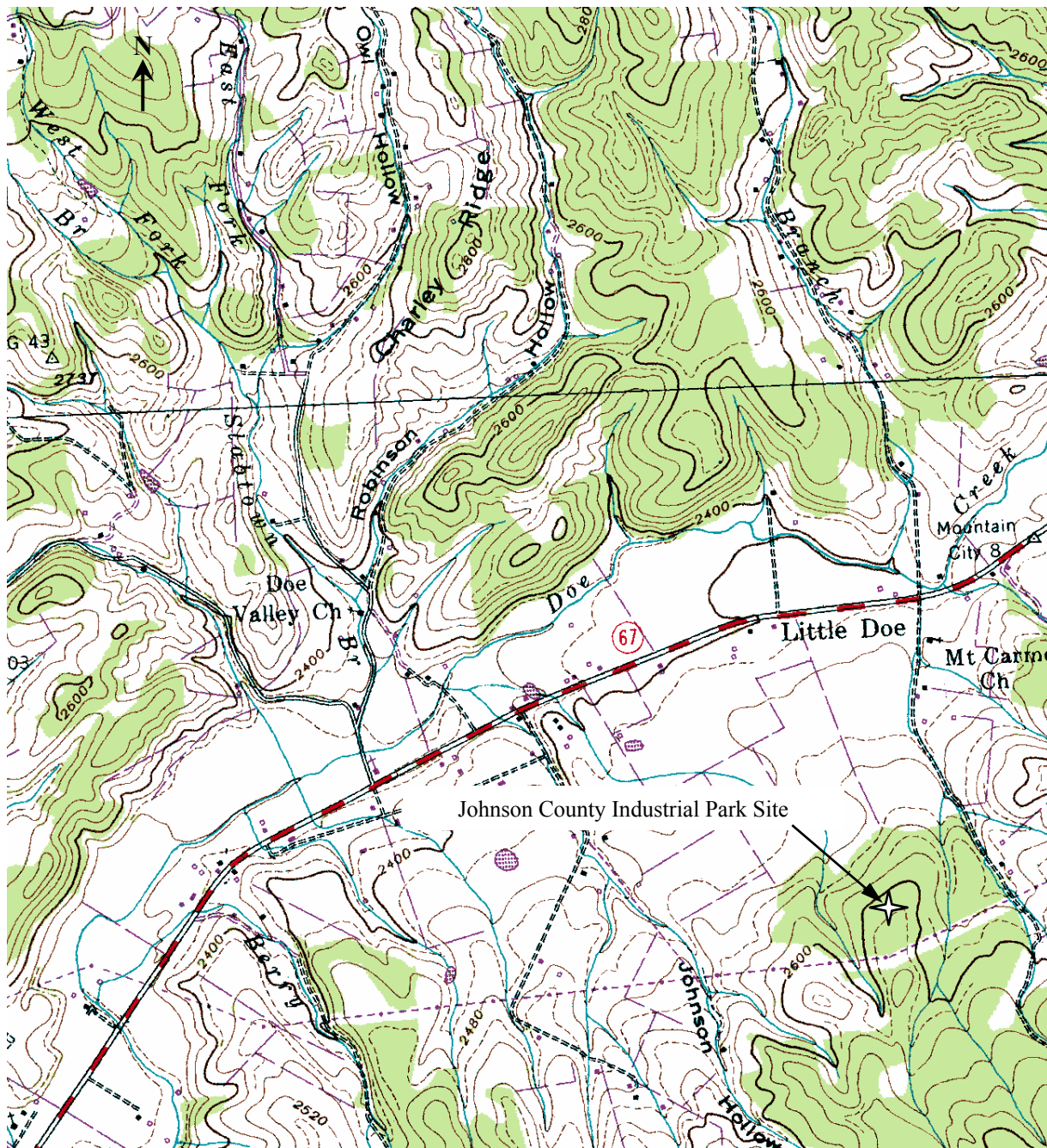


Figure 2-5. Potential Regenesys™ energy storage facility site in Mountain City, TN.

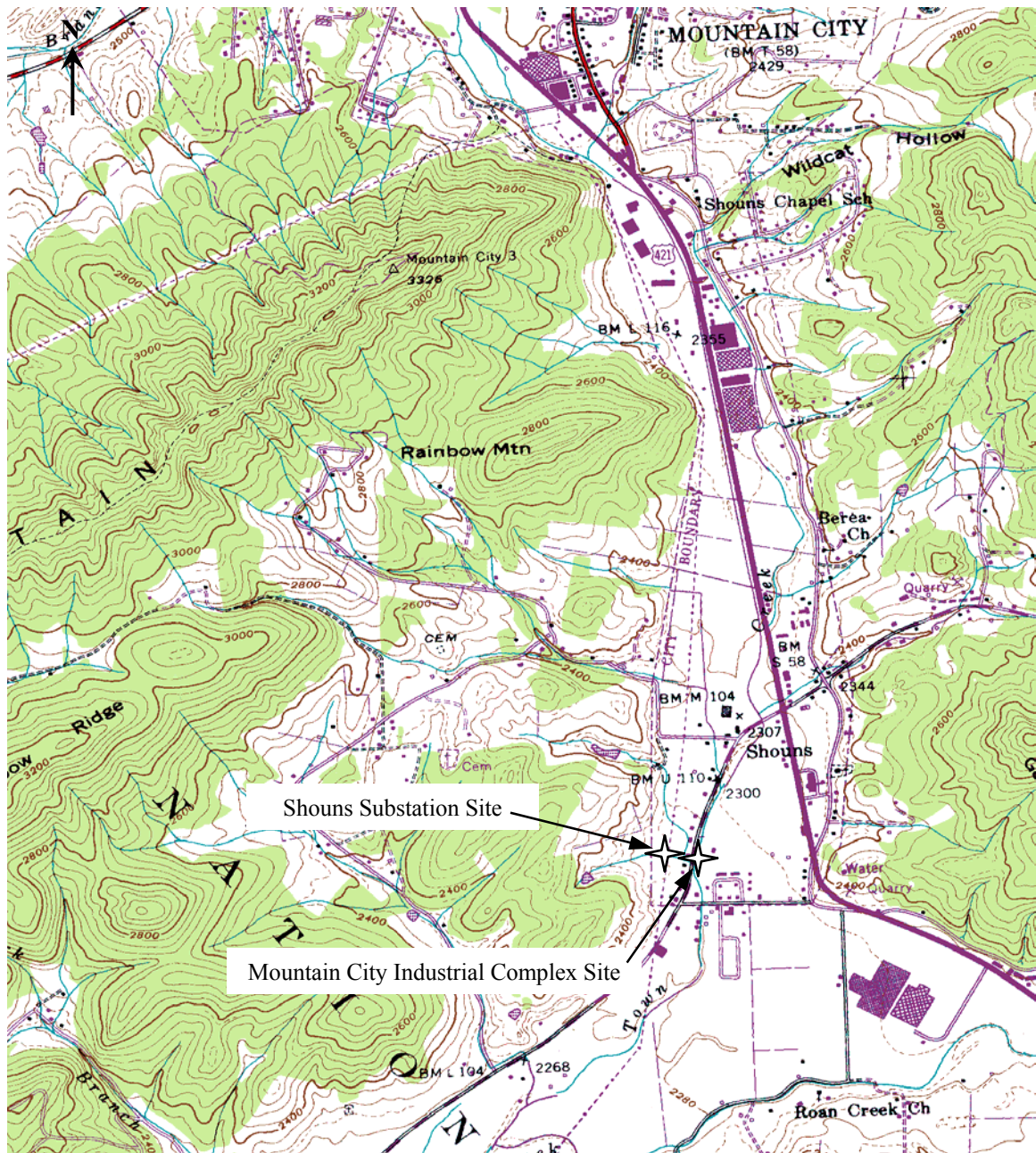


Figure 2-6. Potential Regenesys™ energy storage facility sites in Mountain City, TN

Electrical Connection

The Regenesys™ facility would be connected to the area electrical grid via a short overhead line to the adjacent substation.

Water and Sewage Connections

Water and sewer service lines would connect to the mains running along Highway 167. There would be less than 300 feet of piping required.

*Option 3 - Mountain City Industrial Complex Regenesys™ Site*

This site is about 3 miles south of Mountain City and in an existing industrial park. It is a short distance east and across Roan Creek from the Shouns Substation site.

Access Roads

Dotson Lane and Industrial Drive, both of which are paved, provide access to the industrial park. A short paved road would be constructed from Industrial Drive to the Regenesys™ facility.

Electrical Connection

The Regenesys™ facility would be connected to the area electrical grid via a short overhead line to the nearby Shouns Substation. This electrical line would cross Town Creek.

Water and Sewage Connections

Water and sewer service already exists in the industrial complex and the facility would connect to these lines. There would be less than 600 feet of piping required.

**2.3 Alternative 3 - No Action**

Under the No-Action Alternative, neither the proposed windfarm nor the associated Regenesys™ energy storage facility would be constructed. If this alternative were selected, TVA would need to find other sources of renewable energy in order to expand its Green Power Switch program. TVA would also lose the ability to demonstrate the use of the Regenesys™ energy storage facility in conjunction with intermittent generation from the proposed windfarm.

**2.4 Summary Comparison of the Alternatives**

Selection of either the Alternative 1 – Buffalo Mountain Windfarm Expansion or Alternative 2 – Stone Mountain Windfarm and the subsequent construction and operation of the proposed facilities would have little to no impact on aquatic ecology, solid and hazardous waste management, transportation, environmental justice, and water supply and wastewater. With the implementation of appropriate mitigation, impacts to groundwater under Alternative 1 and Alternative 2 would be insignificant. No impacts to wetlands would occur under Alternative 2, and under Alternative 1, wetlands impacts would be minimized by avoidance and establishment of buffer areas. Both Alternative 1 and Alternative 2 would result in minor impacts, both beneficial and adverse, to socioeconomic resources; these impacts would be somewhat greater under Alternative 1.

Neither Alternative 1 nor Alternative 2 would directly impact managed areas or ecologically significant sites. Implementation of either of these alternatives would affect the view of visitors to nearby managed areas such as parks and wildlife management areas. Both of these alternatives would alter views of the windfarm site from surrounding areas. This change would be most striking under Alternative 2 at Stone Mountain.

Neither Alternative 1 nor Alternative 2 is expected to affect species listed under the Endangered Species Act as Threatened or Endangered. Both alternatives would affect species listed by the State of Tennessee. The listed species at Buffalo Mountain (Alternative 1), are fairly widespread, and, with the implementation of mitigation measures, would not be adversely affected. Some of the listed species at Stone Mountain are known from few other sites in Tennessee, or elsewhere in the Southern Appalachians. Mitigation measures to reduce impacts to these species are listed in this EA.

Both Alternative 1 and Alternative 2 would have minor effects on vegetation and native plant communities. Each of these alternatives would also result in bird and bat mortality as an unavoidable effect of windfarm operation. Bird mortality would likely be somewhat higher under Alternative 2 at Stone Mountain than under Alternative 1 at Buffalo Mountain.

No archaeological resources considered eligible for listing in the National Register of Historic Places were identified within the project area associated with Alternative 1. No archaeological resources were identified on the windfarm site associated with Alternative 2. Archaeological sites were identified on two of the three Regenesys™ associated with Alternative 2; one of these sites is potentially eligible for listing in the National Register of Historic Places. Selection of Alternative 1 would have little effect on historic buildings. Selection of Alternative 2 could have adverse effects on the nearby historic structures.

Under Alternative 1, the windfarm expansion and construction of the Regenesys™ facility at either of the proposed sites would have minor impacts on land uses. Under Alternative 2, construction of the Regenesys™ facility at any of the three sites would have little effect on land uses. Construction of the windfarm on Stone Mountain would result in a change in land use change from forest management to industrial.

Noise from the operation of the windfarm under either Alternative 1 or Alternative 2 would not affect nearby residents. Noise from operation of the Regenesys™ facility at any of the sites under Alternative 1 or Alternative 2 could affect nearby residents and mitigation measures to reduce this impact are discussed.

Selection of either Alternative 1 or Alternative 2 would result in beneficial effects to air quality because of the avoidance of electrical generation from fossil fuels. Under the No Action Alternative, this beneficial effect would not occur in the near future, and TVA would have to seek alternative sources of renewable energy in order to expand the Green Power Switch program.

## **2.5 Preferred Alternative**

TVA's preferred alternative is Alternative 1, the Buffalo Mountain windfarm expansion. TVA intends to build the Regenesys™ facility but at this time does not have a preference among the four potential sites associated with Alternative 1.